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ABSTRACT

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The risk of default that business firms face is very significant and differs widely across countries. This paper explores the links between countries' business conditions and international trade embedment and the default risk at the country level from a theoretical point of view. Our main contribution is to set up a general equilibrium model which allows us to derive sharp predictions concerning how key factors which shape a country's business and trade environment impact on the default risk of firms which operate in these environments. The predictions are in accord with readily available data.

JEL Classification: F12, F13, F15, L25

Keywords: firm death, firm heterogeneity, business conditions and firm productivity, trade integration

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1 Introduction

The risk of default that business firms face is very significant and differs widely across countries. CreditReform (2007; 2009), a private research institute and consultancy, documents that the risk of insolvency varies markedly even within Europe. Using index numbers and a benchmark value of 100 for Germany, CreditReform documents that the risk of firm default is perceived to be as low as 47 for Scandinavian countries and as high as 161 for countries in Eastern Europe (cf. Figure 1).

[**Figure 1 about here]**

A nascent strand of research hypothesizes that policies and institutions that affect the business climate in a broadly defined way are central for the understanding of firm dynamics, and so in particular for business exits (Bartelsmann et al. 2009). Business conditions, which comprehend legal and institutional factors, a country's infrastructure and microeconomic policies as well as macroeconomic factors, differ widely across countries in Europe and even more so worldwide. Hence, one is pushed to stipulate that these conditions are important determinants of producer dynamics. The business environment is also shaped by a country's embedment into world trade, notably by its trade agreements, trade policies and trade infrastructure. Recent evidence shows that the import competition associated with trade and trade liberalization has a strong impact on firm exits (see, inter alia, Bernard et al. 2009; Greenaway et al. 2008; Colantone and Sleuwaegen 2010; Colantone, Coucke and Sleuwaegen 2010).

In highlighting the roles of policies and institutions and in providing evidence about their important roles, this recent research has contributed much to our understanding of the determinants of business exits. What this line of research has not addressed so far and what is as yet not well understood in the literature is the role that particular business factors play for the country-specific exit risks and how these factors interact with trade and trade liberalization. For example, what are the roles of market size, technology policies, and entry regulation policies for the risk of business exit? How do international differences in the business infrastructure play out and what is their significance if trade is liberalized? These are the questions that we address in this paper.

Theoretical guidance is needed to make progress with regard to these issues. Accordingly, it is the aim of this paper to explore the links between countries' business conditions and international trade embedment and the default risk at the country level from a theoretical point of view. Our main contribution is to set up a general equilibrium model which allows us to derive sharp predictions concerning how key factors which shape a country's business and trade environment impact on the default risk of firms. We also provide a first cursory look at empirical data which reveals that our predictions are consistent with the observations. Hence, our model promises to be an adequate starting point for further and deeper empirical investigations.

Our theoretical model considers two countries and two sectors and takes into account that *firms are heterogeneous* in *two dimensions*. First, following the recent theories of heterogeneous firms and trade, we assume that firms in the manufacturing sector differ in terms of their productivities (see, in particular, Melitz 2003, and Redding 2010 for a recent survey). Second, we assume that the default risk of firms is inversely related to their productivity. This assumption draws on the empirical fact that less productive firms are much more likely to exit markets than more productive ones, a finding that has consistently been obtained for a large number of countries.[1] Apparently, more productive firms dispose of greater ability to adapt to their environment and to make higher profits and, hence, have a greater buffer against adverse shocks. This important finding is not taken into account in the Melitz (2003) model and the voluminous literature it has inspired. Rather, these works assume that all firms, irrespective of their productivity, face an identical default risk which is also identical across countries.

Our theoretical analysis focuses on how country-specific exit rates are shaped by business conditions in the long-run.[2] Hence, we explore the steady-state equilibrium of our model. We derive a number of sharp theoretical predictions. First, the expected risk of business exit falls when a country moves from autarky to trade. Intuitively, trade opening induces a competition effect which drives up the productivity threshold to survive and hence the average productivity of firms. The country-specific default risk falls as firms become more productive on average. Second, the effect of trade integration on the country-specific default risk depends on the liberalization path and on the country's business conditions relative to those of its trading partners. More specifically, a country that opens up unilaterally and grants foreign firms better access to its consumers experiences an increase in its default risk whilst the default risk in the trading partner country falls. A symmetric trade integration path reduces the default risk in the two countries if and only if the business conditions in these countries are similar. As soon as

[1] Drawing on a panel of manufacturing plants in the United States, Dunne et al. (1988), Bailey et al. (1992), Doms et al. (1995) and Bernard et al. (2006) document that productivity has a sizable negative effect on the probability of firm exit. Similar findings have been obtained for the UK (Disney et al. 2003), for France (Bellone et al. 2006), for Sweden (Greenaway et al. 2008), for Spain (Esteve-Pérez and Mañez-Castillejo 2008), and for Portugal (Carreira and Teixeira 2009). The link between firm characteristics and entry and exit rates is also highlighted by Einav and Levin (2010) in their progress report on recent developments in the industrial organization literature.
[2] We abstract both from the business cycle as well as from short-run adjustment processes.

one country has significantly better business conditions on average (we make this concept precise in our theoretical analysis), this country experiences a fall in its default risk while the risk of business exit rises in the other country. Third, turning to the effects of business conditions for a given state of trade integration, we show the following: A country's default risk is independent of the size of its population and the size of its trading partner. The country specific-default risk rises when entry investments in this (the other) country rise (fall), when its (the other country's) technical potential falls (rises) and when wage costs in this (the other) country rise (fall). The effect of an increase in the fixed investments necessary to supply the domestic market (i.e. for a distribution or retailing network, the costs of contract enforcement or corruption expenditures) on a country's default risk is to decrease the default risk if trade is sufficiently costly, whilst the default risk in the other country unambiguously falls.

In addition to the strand of research which has begun to analyze producer dynamics across countries that we already alluded to[3], this paper is also related to the emerging literature that explores the consequences of country differences and policy issues in new trade models with heterogeneous firms. Key works are Bernard et al. (2007) who address the effects of differences in relative factor endowments, Melitz and Ottaviano (2008) who scrutinize differences in market-size and trade costs, Demidova (2008) and Falvey et al. (2005) who focus on differences in the technology potential across countries, Baldwin (2005), Baldwin and Forslid (2006) and Feenstra and Kee (2008) who study the welfare effects of trade integration and Demidova and Rodriguez-Clare (2009) who analyze trade policy and welfare issues from the point of view of a small open economy.[4] Importantly, none of the mentioned works accounts for the heterogeneity of the default risk at the firm level that we highlight in our analysis, and therefore none of these contributions is able to address the heterogeneity of default risks at the country level.

The paper proceeds as follows. Our basic model which features two sectors, a monopolistic competitive industry and a traditional constant returns sector, is laid out in section 2. Section 3 derives the open economy equilibrium with two countries. Section 4 contains our analysis of country-specific default risks. Section 5 discusses the predictions of the model in the light of readily available data. Section 6 offers some concluding remarks.

[3] See also the volume edited by Dunne et al. (2009).
[4] A number of further works deserve to be mentioned. Chor (2009) studies FDI subsidies in a two-country setting with heterogeneous firms, Jorgenson and Schröder (2008) explore the effects of exogenous tariffs and Cole and Davis (2009) analyze optimal tariffs. Pflüger and Südekum (2009) focus on entry costs and entry subsidies and study the non-cooperative and cooperative choice entry subsidies. Pflüger and Russek (2011) highlight the role of country asymmetries for trade and industrial policies.

2 The Model

2.1 General set-up

Our model builds on a version of the monopolistic competition model with heterogeneous firms (Melitz 2003) due to Demidova (2008). There are two industries, a traditional numéraire industry, n, which produces a homogeneous good under constant returns to scale and perfect competition and a monopolistic competitive industry, c, which produces a continuum of differentiated manufacturing varieties under increasing returns. Each variety is produced by a single firm and firms are heterogeneous in their productivity. Labor is the only factor of production in both industries. There are L workers who supply one unit of labor each.

Previous works in the tradition of Melitz (2003) counterfactually assumed that all firms face an identical default risk irrespectively of their productivity. In contrast, we assume that the default risk of a firm is inversely related to its productivity, as consistently found in the empirical literature. We also consider an extensive list of business factors: country asymmetries concerning the effective entry costs, the fixed costs to serve domestic and foreign consumers, respectively, trade and transport infrastructure, and productivity differences in the competitive sector, as well as country size differences. We first look at a single autarkic country.

2.2 Preferences

Preferences of household h are defined over the homogenous numéraire commodity and the set of differentiated varieties, $z \in \Omega$, according to a logarithmic quasi-linear utility function with CES sub-utility

$$u^h = \beta \ln c^h + n^h \qquad\qquad c^h = \left[\int_{z\in\Omega} q^h(z)^\rho \, dz \right]^{\frac{1}{\rho}} \tag{1}$$

where $0 < \rho < 1$ and $\beta > 0$ are constant parameters and where $q^h(z)$ expresses household h's consumption of variety z. The elasticity of substitution between any two varieties is given by $\sigma \equiv 1/(1-\rho) > 1$. It is well-known from Dixit and Stiglitz (1977) that c^h can be understood as the consumption of the manufacturing aggregate with aggregate price

$$P = \left[\int_{z\in\Omega} p(z)^{1-\sigma} \, dz \right]^{\frac{1}{1-\sigma}} \tag{2}$$

The budget constraint of an individual is $P c^h + n^h = y^h$, where y^h denotes income. Standard utility maximization implies that per-capita expenditure on the manufacturing aggregate and the numéraire are given by $P c^h = \beta$ and $n^h = y^h - \beta$, respectively. Indirect utility is of the form

$v^h = y^h - \beta \ln P + \beta(\ln \beta - 1)$. The index h will be dropped from now on since households are identical. We impose the assumption $\beta < y$ in order to ensure that the demand for the homogeneous good is non-negative. Aggregate demand for a single variety z is given by $q(z) = p(z)^{-\sigma} P^{\sigma-1} \beta L$, and total revenue for that variety is $r(z) = p(z) q(z) = [P / p(z)]^{\sigma-1} \beta L$. Overall expenditures on manufacturing goods, PcL, equal βL.

2.3 Production and pricing

In the numéraire-sector a units of labor are transformed into one unit of output. This pins down the wage at $w = 1/a$. Technologies in the modern sector are such that $l = f + q/\varphi$ units of labor are needed to produce q units of output. The fixed overhead labor f is the same for all firms, but the variable labor requirement $(1/\varphi)$ differs across firms. Firms have zero mass. Each firm thus faces a residual demand curve with constant price elasticity of demand $-\sigma$. Profit maximization implies that a firm with marginal cost (w/φ) charges the price:

$$p(\varphi) = \frac{\sigma}{\sigma-1}\frac{w}{\varphi} = \frac{w}{\rho\varphi} \tag{3}$$

Revenue and profits of this firm are then given by $r(\varphi) = \beta L(\rho\varphi P / w)^{\sigma-1}$ and $\pi = r(\varphi)/\sigma - wf$, respectively. Hence, the firm with higher productivity level φ charges a lower price, sells a larger quantity and has higher revenue and profits. Since all firm-specific variables differ only with respect to φ, the CES price index (2) can be rewritten as

$$P = M^{1/(1-\sigma)} p(\tilde{\varphi}) = M^{1/(1-\sigma)} \frac{w}{\rho\tilde{\varphi}} \qquad \text{with } \tilde{\varphi} \equiv \left[\int_0^\infty \varphi^{\sigma-1} \cdot \mu(\varphi)\, d\varphi\right]^{1/(\sigma-1)} \tag{4}$$

where M denotes the mass of manufacturing firms (and varieties) in the market, $\mu(\varphi)$ is the productivity distribution across these active firms (with positive support over a subset of $(1,\infty)$) and $\tilde{\varphi}$ is an average productivity level of firms in the market as introduced by Melitz (2003).

2.4 Entry, exit and parameterization

There exists a mass of potential entrepreneurs who can enter the manufacturing sector subject to a sunk entry investment in terms of labor f_e. At each point in time a mass of M^E entrepreneurs decides to enter. Upon entry these entrepreneurs learn about their productivity φ, which is drawn from a common and known density function $g(\varphi)$ with support $(1,\infty)$ and cumulative density function $G(\varphi)$. We call this the 'productivity lottery'. After the productivity level is revealed, an entrant can decide to exit immediately or to remain active in the market, in which case the firm earns constant per-period profits $\pi(\varphi)$. It will exit immediately if $\pi(\varphi) < 0 \leftrightarrow r(\varphi) < \sigma w f$. Only those firms remain active whose productivity draw exceeds the cutoff $\varphi^* > 0$ at which profits are zero, $\pi(\varphi^*) = 0$.

Once in the market, every firm may be hit by a lethal shock which forces it to shut down and exit the industry.[5] The empirical evidence that we have discussed in section 1 strongly suggests that less productive firms face a higher risk of market exit than more productive ones. A tractable way to express this notion is to assume that the firm-specific death rate is given by $\delta(\varphi) = 1/\varphi$. We focus on a stationary equilibrium without time discounting such that in each period the mass of entrants which successfully enter the market equals the mass of firms that are forced to shut down. Analytically, $prob_i\, M^E = E[\delta(\varphi)|\varphi > \varphi^*]M$, where $E[\delta(\varphi)|\varphi > \varphi^*]$ is the expected rate of firm death and $prob_i = 1 - G(\varphi^*)$ is the probability to draw a productivity no smaller than the cutoff φ^*.

Our novel assumption that a firm's exit risk negatively depends on its productivity involves considerable intricacies. To see this it is useful to recall the standard Melitz model which assumes that a firm's exit risk is constant. It is well-known from Melitz (2003) that this assumption together with the market entry lottery implies that in a stationary equilibrium the distribution of firms in the market, $\mu(\varphi)$, coincides with the conditional (left-truncated) ex-ante distribution $g(\varphi)$. Parameterizations of this standard Melitz-model usually stipulate that the ex-ante distribution of firm productivities is a Pareto-distribution, i.e. $G(\varphi) = 1 - (\varphi_{\min}/\varphi)^k$ and $g(\varphi) = G'(\varphi) = k\varphi_{\min}^k \varphi^{-k-1}$ where $\varphi_{\min} > 1$ is the lower bound for productivity draws which can be understood to capture a country's technology potential, and where $k > 1$ is the shape parameter (e.g. Helpman et al. 2004; Baldwin 2005). Under this parameterization, the ex-ante distribution of productivities, the conditional ex-ante distribution and the distribution of firms in a steady state equilibrium follow a Pareto-distribution. Moreover, the Pareto-parameterization is appealing because it conforms with the empirical evidence concerning the productivities of firms that are observed in the markets.[6]

However, if the exit risk of firms is productivity-dependent, it no longer holds true that the distribution of firms in a steady state equilibrium, $\mu(\varphi)$, coincides with the conditional (left-

[5] We follow Melitz (2003) and assume that once a firm is hit by a lethal shock it leaves the market instantaneously. Hopenhayn (1992) offers a dynamic analysis of firm exit. Atkeson and Burstein (2010) extend the Melitz-model in the spirit of Hopenhayn.
[6] See e.g. Del Gatto et al. (2006) and Ikeda and Suoma (2009).

truncated) ex-ante distribution $g(\varphi)$. Intuitively, unlike in the Melitz-model, the sample of exiting firms is now systematically biased towards firms with lower productivities. In fact, even if we specified the ex-ante distribution of productivities to be a Pareto-distribution, it is unclear what the implied distribution of productivities in a stationary market equilibrium would look like. To cut through these complications we proceed inversely: the empirical evidence tells us that the distribution of firm productivities *in the market* is a Pareto whilst we do not know and cannot observe how the ex-ante distribution of firm productivities looks like. Hence, we impose the Pareto-parameterization for the stationary equilibrium and we allow the ex-ante distribution $g(\varphi)$ and its left-truncation to be unknown. We merely have to assume that $g(\varphi)$ together with the productivity dependent exit process (where $\delta(\varphi) = 1/\varphi$) generate a stable market equilibrium that leads to a Pareto distribution of active firms. These assumptions suffice to solve our model with productivity-dependent exit risks.

2.5 Equilibrium in the closed economy

The equilibrium within the manufacturing sector can be characterized as in Melitz (2003) by two conditions, a free entry condition (FEC) and a zero cutoff profit condition (ZCPC). The FEC captures the individual market entry decisions of entrepreneurs which are based on the productivity distribution in the productivity lottery. To derive the FEC note that, assuming risk neutrality, potential entrepreneurs enter the market (i.e. incur the entry cost $w\,f_e$ to participate in the productivity lottery) until the value of entry $v^E = E\left[\sum_{t=0}^{\infty}(1-\delta(\varphi))^t\,\pi(\varphi)\right] - w\,f_e = E[\pi(\varphi)/\delta(\varphi)] - w\,f_e = [1-G(\varphi^*)]E[\pi(\varphi)/\delta(\varphi)|\varphi > \varphi^*]$ is driven to zero. The resulting FEC is given by (see appendix A):

$$\text{(FEC)} \qquad \pi(\varphi') = \frac{\delta(\varphi')w\,f_e}{1-G(\varphi^*)} + w\,f\,\delta(\varphi')\left\{ \mathrm{E}\left[\frac{1}{\delta(\varphi)}\middle|\varphi > \varphi^*\right] - \frac{1}{\delta(\varphi')}\right\} \qquad (5)$$

where $\varphi' \equiv E\left[\varphi^\sigma \middle| \varphi > \varphi^*\right]^{1/\sigma}$ is a suitably defined auxiliary expected productivity. Note that the entrepreneurs base their entry decisions solely on the distribution in the productivity lottery. Hence, all expected values (this includes φ') depend only on the distribution in the lottery and are independent of the distribution of active firms. The distribution of active firms influences the revenue of a firm through the price index, as $r(\varphi) = \beta L(\rho\varphi P/w)^{\sigma-1}$. However, since our calculations involve the ratio $r(\varphi)/r(\varphi')$, the price index cancels out.

The ZCPC states that the cutoff firm makes zero profits, $\pi(\varphi^*) = 0 \leftrightarrow r(\varphi^*) = \sigma\, w\, f$. Using $\pi(\varphi') = [r(\varphi')/\sigma] - w\, f$, and $r(\varphi^*) = (\varphi^* / \varphi')^{\sigma-1} r(\varphi')$, this condition can be expressed as a function of the auxiliary average productivity level φ':

$$\text{(ZCPC)} \qquad \pi(\varphi') = \left[\left(\frac{\varphi'}{\varphi^*} \right)^{\sigma-1} - 1 \right] w\, f \qquad (6)$$

Although this ZCPC corresponds qualitatively to the one stated in Melitz (2003) we have formulated it in terms of φ' to facilitate the derivations that follow. The equilibrium is determined by the productivity φ^*_{aut} which simultaneously satisfies the FEC and the ZCPC. Equating eqs. (5) and (6), using $\delta(\varphi') = 1/\varphi'$, $\varphi'^{\sigma} \equiv E\left[\varphi^{\sigma} \middle| \varphi > \varphi^*\right] = \frac{1}{1-G(\varphi^*)} \int_{\varphi^*}^{\infty} \varphi^{\sigma} g(\varphi) d\varphi$ and $\left[1 - G(\varphi^*)\right] \cdot E\left[\varphi \middle| \varphi > \varphi^*\right] = \int_{\varphi^*}^{\infty} \varphi g(\varphi) d\varphi$, the cutoff φ^* is implicitly defined by the equilibrium condition:

$$f \cdot j\left(\varphi^*_{aut}, g\left(\varphi^*_{aut}\right)\right) = f_e \quad \text{where} \quad j\left(\varphi^*_{aut}, g\left(\varphi^*_{aut}\right)\right) \equiv \frac{\int_{\varphi^*_{aut}}^{\infty} \varphi^{\sigma} g(\varphi) d\varphi}{\varphi^{*\sigma-1}_{aut}} - \int_{\varphi^*_{aut}}^{\infty} \varphi\, g(\varphi) d\varphi \qquad (7)$$

The LHS of eq. (7) is the present discounted value of the expected profits, the RHS shows the entry investment. In appendix B we show that $f \cdot j\left(\varphi^*, g\left(\varphi^*\right)\right)$ is a decreasing function in φ^* and intersects f_e only once. This ensures the uniqueness of the equilibrium.

Once the equilibrium cutoff φ^*_{aut} is determined, the average productivity of firms in the market can be derived as in Melitz (2003) as well as the expected (average) exit rate of the economy. In order to conform to the empirical evidence and to obtain closed-form solutions we assume that the productivities of firms in the market follow a Pareto-distribution as specified in the previous section. The average productivity is then given by $\tilde{\varphi} = [k/(k-(\sigma-1))]^{1/(\sigma-1)} \varphi^*$. Using $\delta(\varphi) = 1/\varphi$, the expected exit rate can be derived as: $E\left[\delta(\varphi) \middle| \varphi > \varphi^*\right] = [k/(k+1)]\, \varphi^{*-1}$. Making use of the equilibrium condition (7) we obtain:

PROPOSITION 1. (Country-specific default risk under autarky). *The expected (average) risk of business exit in a closed economy, is independent of country size L and the labor coefficient in the traditional sector a, negatively related to the degree of competition σ, the* *technological potential and the fixed labor input to the serve market f, and positively related to the fixed investment of entry labor f_e.*

Proof. The proposition is proven by implicit differentiation of eq. (7) as shown in appendix B. ■

A remark concerning our conceptualization of a country's technology potential is in order here: As we depart from a general ex-ante distribution of firm productivities, $g(\varphi)$, we model differences in technological potential by hazard rate stochastic dominance (HRSD) as in Demidova (2008). A productivity distribution $G_a(\varphi)$ stochastically dominates a distribution $G_b(\varphi)$ in terms of the hazard rate order, $G_a(\bullet) \succ_{hr} G_b(\bullet)$, if $g_a(\varphi)/[1-G_a(\varphi)] < g_b(\varphi)/[1-G_b(\varphi)]$ holds true for any given productivity level φ. HRSD allows us to compare the expectations of an increasing function above a given cutoff level, i.e. if $y(x)$ is an increasing function, then $E_H[y(x)|x > \varphi] > E_F[y(x)|x > \varphi]$. Put intuitively, firms drawing from $G_a(\varphi)$ have a greater chance of getting a higher productivity level above this level than firms drawing from $G_b(\varphi)$. In Appendix B we show that a HRSD technology implies a higher cutoff productivity.

Proposition 1 highlights how particular business factors affect the country-specific default risk under autarky. A greater technological potential and/or lower investments for market entry increase the expected profitability to produce manufacturing goods. This stimulates market entry and tightens competition and thus forces the least productive firms to close down. Similarly, higher fixed labor investments set in a selection effect which drives the least efficient firms out of the market. Consequently, the average insolvency risk decreases as the average productivity of firm rises. The equilibrium cutoff-productivity φ^*_{aut} is unaffected both by the country size and by the wage (which is tied to the labor coefficient in the competitive sector a). Clearly, these are intermediate results, only, since they do not involve international repercussions. To explore these, we turn to the open economy now.

3 The Open Economy

3.1 Assumptions

We now turn to an open economy setting with two countries $i, j \in [H, F]$, say home H and foreign F. These two countries potentially differ in a number of characteristics which determine the conditions of doing business. There may be differences in country size L_i and in the labor coefficient in the competitive sector a_i. Technologies in the manufacturing sector do not have to be identical: we assume that entrants in country i draw their productivity from a country-specific lottery distribution $G_i(\varphi)$ which may dominate the productivity distribution $G_j(\varphi)$ of the other country in terms of the hazard rate order. We also allow the fixed labor input for entry in the manufacturing sector $f_{e,i}$ and the fixed labor input f_i to serve domestic markets to differ across countries. If (after learning its productivity φ_i) a firm from country i decides to export to region j it faces an additional country-specific fixed cost f_{xi}, on top of the domestic per-period fixed costs f_i that accrue irrespectively of export status. Moreover, firms have to incur variable iceberg costs to serve foreign consumers: for one unit to arrive in j, a firm from country i has to ship $\tau_{ij} > 1$ units. We shall allow for the possibility that $\tau_{ij} \neq \tau_{ji}$, e.g. due to different trade policies or trade infrastructures. Trade in the competitive sector is costless. As long as both countries produce this good, an assumption that we shall maintain throughout the paper, the law of one price dictates that the foreign wage is tied to the domestic wage, $W \equiv w_F / w_H = a_H / a_F$ where W denotes the relative foreign wage. Note that $w_i = 1/a_i$ by our choice of the numéraire.

3.2 The international equilibrium

The international equilibrium is determined by the conditions of free entry and zero cutoff profits which become interdependent across countries in the open economy. If a manufacturing firm from country i exports to country j, its profits from exporting are given by $\pi_{xi}(\varphi) = r_{xi}(\varphi)/\sigma - w_i \cdot f_{xi}$ where $r_{xi}(\varphi) = (\tau_{ij} w_i / \rho\varphi)^{1-\sigma} P_j^{\sigma-1} \beta L_j$ is the export revenue. There is a critical productivity threshold φ_{xi}^* where such a firm just breaks even on the export market, i.e. $\pi_{xi}(\varphi_{xi}^*) = 0 \Leftrightarrow r_{xi}(\varphi_{xi}^*) = \sigma w_i \, f_{xi}$. We call this the *export ZCPC*. Furthermore, a manufacturing firm from country i that serves her home market i derives profits $\pi_i(\varphi) = r_i(\varphi)/\sigma - w_i \, f_i$ where $r_i(\varphi) = (w_i / \rho\,\varphi)^{1-\sigma} P_i^{\sigma-1} \beta\, L_i$ is the associated revenue. The cutoff φ_i^* where this firm breaks even is defined by $\pi_i(\varphi_i^*) = 0 \Leftrightarrow r_i(\varphi_i^*) = \sigma w_i \, f_i$. We call this the *domestic ZCPC*. The revenue equations imply a link between export cutoffs and domestic cutoffs, $\varphi_{xH}^* = W^{-\sigma/(\sigma-1)} t_H \; \varphi_F^*$ and $\varphi_{xF}^* = W^{\sigma/(\sigma-1)} t_F \; \varphi_H^*$ where $t_i \equiv \tau_{ij} \left(f_{xi} / f_j \right)^{1/(\sigma-1)}$ is a measure of trade costs (see appendix C). Throughout the paper we impose the assumption

$f_{xi} / f_j > \tau_{ij}^{1-\sigma} \left(w_j / w_i \right)^{\sigma} \left(\varphi_i^* / \varphi_j^* \right)^{\sigma-1}$ to ensure that only firms that produce in the domestic market can export (i.e. $\varphi_{xi}^* > \varphi_i$).

The free entry condition (FEC) for country *i* commands that firms enter the market until the value of entry is zero, $prob_i \, \mathrm{E}\left[\frac{\pi_i(\varphi)}{\delta_i(\varphi)} \middle| \varphi > \varphi_i^* \right] + prob_{xi} \, \mathrm{E}\left[\frac{\pi_{xi}(\varphi)}{\delta_i(\varphi)} \middle| \varphi > \varphi_{xi}^* \right] = w_i \; f_{ei}$. The first term on the LHS formalizes the expected profits on the domestic market and the second term the expected profits on the export market where $prob_{xi} = 1 - G(\varphi_{xi}^*)$ denotes the probability for a productivity draw high enough to enter the export market. The RHS expresses the entry costs. The international equilibrium is determined by the following conditions (see appendix D):

$$H\left(\varphi_H^*, \varphi_F^*\right) \equiv f_H \, j_H\left(\varphi_H^*\right) + f_{xH} \, j_H\left(W^{-\sigma/(\sigma-1)} \, t_H \;\; \varphi_F^*\right) - f_{eH} = 0$$

$$F\left(\varphi_H^*, \varphi_F^*\right) \equiv f_F \, j_F\left(\varphi_F^*\right) + f_{xF} \, j_F\left(W^{\sigma/(\sigma-1)} \, t_F \;\; \varphi_H^*\right) - f_{eF} = 0 \qquad (8)$$

with $j_i\left(\varphi^*\right) \equiv \int_{\varphi^*}^{\infty} \varphi^{\sigma} g_i(\varphi) d\varphi \Big/ \varphi^{*\sigma-1} - \int_{\varphi^*}^{\infty} \varphi \, g_i(\varphi) d\varphi$.

In what follows we assume that the countries must not be too different such that positive and meaningful cutoff productivities and exit rates exist for both countries (see appendix E).

4 Business exits in the open economy

We assume that the two countries are diversified in production before and after trade. Section 4.1 begins with the impact of trade opening on national average exit risks. Section 4.2 addresses the impact of trade integration, and section 4.3 analyses the role of business conditions and policy reforms.

4.1 The evolution of exits risks from autarky to trade

A comparison of the equilibrium conditions under international trade in eq. (8) and under autarky (7) immediately implies

PROPOSITION 2. (Country-specific default risk under trade). *Trade opening decreases the the expected (average) risk of business exit of a country.*

Proof: The functions $j_i\left(\varphi_i^*\right)$ and $j_i\left(\varphi_{xi}^*\right)$ are decreasing functions in φ^* (see appendix B). Hence, the cutoff under international trade φ_i^* is greater than under autarky. Using $E\left[\delta(\varphi) \middle| \varphi > \varphi^*\right] = \left[k / (k+1)\right] \varphi^{*-1}$ immediately implies Prop. 2. ■

Opening up to trade forces the least productive firms to exit the market, so that the average productivity of the economy rises. As more productive firms have a lower risk of market exit, the expected risk of business exit must decrease.

4.2 Business exits under trade integration

How is the country-specific exit rate affected by trade liberalization? We start with the case of unilateral trade integration where one country (say j) allows firms located in i better access to its consumers. Such unilateral integration is captured by reductions in variable trade costs τ_{ij} and/or by reductions in the fixed export costs f_{xi}. Our results are summarized in:

PROPOSITION 3. (Default risks under unilateral trade integration). *A unilateral reduction in variable and/or fixed trade costs to serve market j leads to a higher average default risk in country j and to a lower exit risk in country i.*

Proof: The claim follows by implicit differentiation of eqs. (8) to obtain the effects of τ_{ij} and f_{xi} on φ_i^* and φ_j^* (see appendix E) and by making use of $E[\delta(\varphi)|\varphi > \varphi^*] = [k/(k+1)]\,\varphi^{*-1}$. ■

Proposition 3 gives the remarkable insight that the country-specific default risks depend on the level of trade integration. This theoretical insight is, to the best of our knowledge, completely novel and has not yet been explored empirically. Granting firms located in country i better access to consumers located in country j (by reductions in variable and/or fixed export costs) raises the profitability to produce manufacturing varieties in country i. This stimulates entry and tightens competition in i. The least productive firms are driven out of the market in i, so that the average default risk in i falls. The foreign market, instead, becomes less profitable for local (foreign) firms. This reduces the incentive for foreign firms to enter the market. Competition is thus weakened resulting in a reduction in the foreign productivity cutoff which raises the average exit risk in j.

We now analyze the case of a symmetric reduction in trade costs $d\,t_H = d\,t_F < 0$. This may comprehend a reduction in variable (iceberg) trade costs and/or a reduction in fixed costs to serve the foreign market (since $\partial t_i / \partial \tau_{ij} > 0$ and $\partial t_i / \partial f_{xi} > 0$, respectively). We obtain:

PROPOSITION 4. (Default risks under symmetric trade integration). *If countries differ strongly with respect to business conditions, a symmetric reduction in trade costs ($d\,t_H = d\,t_F < 0$) increases the average default risk of the country which has an aggregate* *disadvantage in business conditions, whereas the other country's exit risk decreases. Otherwise, both countries exhibit lower national exit risks.*

Proof. To prove the claim we totally differentiate $\varphi_i^* = \varphi_i^*(t_i, t_j)$, impose $d\,t_H = d\,t_F > 0$, take the derivatives of the equilibrium cutoffs $\partial\varphi_i^* / \partial t_i$ and $\partial\varphi_i^* / \partial t_j$ for i, j and then explore the sign of the derivatives (see appendix E). ■

Propositions 3 and 4 establish a link between trade and trade infrastructure policy and national average exit risks. While unilateral policy measures have an unambiguous impact on business risks at the country level, this does not hold true for symmetric (bilateral) policy measures. Rather, a comprehensive set of business factors determines the sign and the strength of this link.

4.3 Business conditions and exit risks

An inspection of eqs. (8) makes it evident that the international equilibrium depends on a set of business conditions. In this section we analyze the link between national business conditions and the average risk of market exit. We obtain:

PROPOSITION 5. (Country-specific default risk under international trade). *The expected risk of business exit in country* i, $E[\delta(\varphi)|\varphi > \varphi_i^*] = [k/(k+1)]\,\varphi_i^{*-1}$, *(i) is independent of country sizes* L_i *and* L_j, *(ii) increases when entry investment* f_{ei} *is higher, when the domestic wage* w_i *is higher, and when the technological potential is smaller, and (iii) increases when foreign entry investment* f_{ej} *is lower, when the foreign wage* w_j *decreases, and when the foreign technological potential increases.*

Proof. The proof follows the one we gave for Proposition 3 (see also appendix E). ■

Intuitively, any improvement in business conditions in country i, such as a better technology potential, lower entry investments and lower wages, raises the profitability of the domestic market and gives local firms a competitive edge over their foreign competitors. This stimulates entry in country i and reduces the incentive to enter the manufacturing industry in country j, which sets in a selection effect that leads to higher cutoffs and a lower average exit risk in i and lower cutoffs and a higher average exit risk in j.

In contrast to the factors considered in proposition 5 changes in the domestic fixed labor investment necessary to serve the domestic market have an ambiguous effect on national default risks as stated in:

PROPOSITION 6. (The effect of domestic fixed labor investment). *An increase in domestic fixed labor investment (* f_i *) leads to (i) a decrease in the domestic expected exit rate iff the domestic market is sufficiently protected from foreign competition, i.e. if market access to its market is sufficiently costly, and (ii) an unambiguous decrease in the expected exit rate in country* j.

Proof. The method of proof follows the one employed to prove the previous propositions. ■

Proposition 6 shows a remarkable difference to our finding for the closed economy. In the closed economy, an increase in f necessarily drives up the productivity cutoff due to a stronger selection effect and reduces the expected exit rate. In the open economy, an increase in f_i has a further effect, it facilitates the access of foreign firms to the domestic market, as $dt_j / df_i < 0$. This implies a competitive disadvantage for domestic firms vis-à-vis their foreign competitors whose effect it is to reduce the incentive to enter the domestic market and, hence, to raise the domestic expected insolvency risk. This leads to the ambiguity. However, the impact on the foreign expected exit risk is negative, as firms from j now enjoy a comparative advantage.

Propositions 5 and 6 reveal a crucial link between policy reforms and average exit risks. In practice, the necessary fixed investments to start and do business are associated with a country's level of corruption, the costs to enforce contracts, the costs to provide protection against crime, product piracy and product imitation. Technology policies have an influence on a country's technological potential. Furthermore, proposition 6 carries the important message for empirical research that changes in the fixed input to do business are not unambiguously related to average exit risks.

5 Discussion

Our theoretical analysis throws up a number of sharp and interesting predictions which ultimately warrant closer empirical investigation. This section intends to give a first look at our predictions in the light of the data. A crucial problem that one encounters when moving from theory to empirics concerns the non-availability of comparable cross-country data on firm exits (in fact on firm dynamics, i.e. firm entry, exit and turnover, more broadly). Great efforts have been made to develop statistics on firm dynamics in many countries in recent years (see Dunne et al. 2009). These efforts have largely been independent, however, and so the data reflect strong country idiosyncrasies. For example, in contrast to Germany, countries like Spain, Italy and Greece do not embrace small enterprises in their statistics. Hence their insolvency rates are biased downwards. Moreover, in these Mediterranean countries firms often choose less formal and juridical ways to deal with bankruptcy which are also not included in the data (e.g. a settlement or a moratorium, see CreditReform 2007, 2009). An important recent initiative involving researchers from more than 20 countries has started to standardize data definitions and to construct comparable statistics (see Bartelsmann et al., 2009). However, despite intensive efforts measurement differences still exist as Bartelsmann et al. (2009) point out.[7] For this reason the ensuing analysis builds on the CreditReform (2009) data that we already alluded to in the introduction and that involve *perceived insolvency risks (PIR)*. Such perceptions have their own methodological weaknesses but they allow us to make cross-country comparisons.

Before turning to the role of specific factors highlighted in our propositions it is worthwhile to look at the correlation between a country's average productivity and its perceived insolvency risk. In our model the average productivity of domestic firms is positively related to the domestic cutoff productivity (see section 2.5) which itself is inversely related to a country's expected risk of business exits (see section 4.1). The predicted negative relationship is clearly borne out by Figure 2(i) which depicts the *PIR* against the average gross value added per hour (we define and describe all our data in appendix F.)

[Figure 2 about here]

Turning to the role of trade liberalization Figure 2(ii) reveals that the trading across borders rank (which captures the ease of export and import activities of local firms) is positively correlated with the *PIR*. This is in the spirit of proposition 3 which predicts that a country's default risk is lower the better its access to its trading partner.

Moving on to particular business factors note that Figures 2(iii), 2(iv), 2(v) clearly bring out a positive correlation between the *PIR* and various measures of business entry costs, i.e. the ease of doing business rank, the number of days it takes to open a business and the cost and time to open up a business in percent of the GDP. The corruption perception index which can be interpreted as an inverse measure of these business entry costs is negatively related to the PIR as shown in Figure 2(vi). Figure 2(vii) reveals a negative relationship between the R&D-spending in percent of the GDP, which take as a proxy for a country's technology potential, and the *PIR*.

[7] Bartelsmann et al. (2009: 3) state that "Some core cross-country comparisons will be problematic because of remaining possible measurement problems, but also because some firm-level indicators cannot be unequivocally linked to better or worst economic performance". They also conclude that "… harmonization [of data] is essential to conduct meaningful comparisons, but we acknowledge that our effort should probably be extended as there remain measurement problems [so that] simple comparisons of firm dynamics across countries remain difficult to interpret [...]"(Bartelsmann et al. 2009:44).

The correlations documented in Figures 2(iii) – (vii) are consistent with the prediction of proposition 5.

The relationship between country size, i.e. population, and the *PIR* is shown in Figure 2(viii). We see that the *PIR* is independent of the country size as predicted by proposition 5. Finally, Figure 2(ix) depicts the relationship between the *PIR* and purchasing power adjusted labour compensation per employee. No clear pattern emerges here in contrast to the prediction of proposition 5. However, as the *PIR* is determined by many factors jointly, the contribution of a single factor may not become visible.[8]

The correlations show that many of the predictions of our theoretical model are broadly consistent with readily available data for European countries. A number of caveats have to be made, however. First, it is hard to provide correlations for all factors that we have put under scrutiny in our theoretical model. This is particularly true for the transition from autarky to trade addressed in proposition 2 for which there are no available data. A similar problem applies to proposition 4 which involves a comprehensive indicator for business factors which is important under trade liberalization. Second, we hasten to point out that our quick view on the data involves correlations but not causality. Clearly, solid econometric work is needed to tackle the causality issue. Finally, further and better data which overcome measurement problems hopefully become available in the near future to put the analysis on a better footing. It is also desirable to have a much broader sample of countries worldwide.

6 Conclusion

This paper contributes to recent research which focuses on the roles of policies and institutions as determinants of business exits. It sets up a general equilibrium model which allows to derive sharp predictions concerning how key factors which shape a country's business and trade environment impact on the average default risk of firms. We show that the switch from autarky to trade reduces the country-specific default risk. Unilateral trade liberalization reduces the default risk of countries whose firms gain better market access and increases the default risk of the liberalizing country. Multilateral trade liberalization reduces the risk of business exit in both countries if and only if they offer similar (overall) business conditions. Otherwise, the default risk in the country with 'better' business conditions falls whilst the opposite holds for the other country. We also show that a country's default risk is independent of the size of its population

[8] It should also be noted that the predictions of our theoretical model conform with the empirical findings documented in Greenaway et al. (2008) and Coucke and Sleuwaegen (2008).

and the size of its trading partner. However, the country specific-default risk rises when entry investments in this (the other) country rise (fall), when its (the other country's) technical potential falls (rises) and when wage costs in this (the other) country rise (fall). The effect of an increase in the fixed investments necessary to supply the domestic market (i.e. for a distribution or retailing network) on a country's default risk is to decrease the default risk if trade is sufficiently costly, whilst the default risk in the other country unambiguously falls.

A first look at empirical data reveals that our predictions are consistent with the observations, i.e. the correlations between the perceived insolvency risk, that we use as a measure for the country-specific default risk, and various business conditions correspond to our theoretical predictions. Thus, our model is a promising starting point for further and deeper empirical investigations. It is hoped that these investigations can draw on actual rather than perceived country default risks once comparable country data void of measurement problems are available. Clearly, a further task is to move on from the correlations that we offer in our first data look to an analysis of causality.

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Appendices

Appendix A The free entry condition (FEC) in the closed economy

From $\pi(\varphi)=r(\varphi)/\sigma-wf$ it follows that

$$E\left[\frac{\pi(\varphi)}{\delta(\varphi)}\middle|\varphi>\varphi^*\right]=\frac{1}{\sigma}E\left[\frac{r(\varphi)}{\delta(\varphi)}\middle|\varphi>\varphi^*\right]-wfE\left[\frac{1}{\delta(\varphi)}\middle|\varphi>\varphi^*\right]$$

Using $r(\varphi)=(\varphi/\varphi')^{\sigma-1}r(\varphi')$ and $\delta(\varphi)=\delta(\varphi')\varphi'/\varphi$, it holds true that

$$E\left[\frac{\pi(\varphi)}{\delta(\varphi)}\middle|\varphi>\varphi^*\right]=\frac{1}{\sigma}\frac{r(\varphi')}{\delta(\varphi')}(\varphi')^{-\sigma}E\left[\varphi^{\sigma}\middle|\varphi>\varphi^*\right]-wfE\left[\frac{1}{\delta(\varphi)}\middle|\varphi>\varphi^*\right]$$

where $\mathrm{E}\left[\varphi^{\sigma}\middle|\varphi>\varphi^*\right]=(\varphi')^{\sigma}$. Adding and subtracting $f/\delta(\varphi')$ on the RHS leads to

$$E\left[\frac{\pi(\varphi)}{\delta(\varphi)}\middle|\varphi>\varphi^*\right]=\frac{\pi(\varphi')}{\delta(\varphi')}-wf\left(E\left[\frac{1}{\delta(\varphi)}\middle|\varphi>\varphi^*\right]-\frac{1}{\delta(\varphi')}\right).$$

Using this expression in the value of entry, $v^E=[1-G(\varphi*)]\cdot\mathrm{E}\left[\pi(\varphi)/\delta(\varphi)\middle|\varphi>\varphi^*\right]-w\cdot f_e$, equating this to zero and then solving for $\pi(\varphi')$ gives the FEC stated in eq. (5).

Appendix B – The equilibrium condition under autarky

<u>Existence and uniqueness of the equilibrium</u>

Consider the equilibrium condition under autarky $f\cdot j(\varphi^*_{aut})=f_e$ where $j(\varphi^*)\equiv j(\varphi^*,g(\varphi^*))=\int_{\varphi^*}^{\infty}\varphi^{\sigma}g(\varphi)d\varphi\Big/\varphi^{*\sigma-1}-\int_{\varphi^*}^{\infty}\varphi\, g(\varphi)d\varphi$. The limits of the LHS are given by $\lim_{\varphi^*\to 1} j(\varphi^*)=E[\varphi^{\sigma}-\varphi]>0$ and $\lim_{\varphi^*\to\infty} j(\varphi^*)=0$. By applying Leibniz' rule, the slope of $j(\varphi^*)$ is given by $\frac{dj(\varphi^*)}{d\varphi^*}=-(\sigma-1)\frac{\varphi'}{\varphi^{*\sigma}}[1-G(\varphi^*)]<0$ which is unambiguously negative. To ensure the existence and the uniqueness of the equilibrium we have to assume that $\lim_{\varphi^*\to 1} f\cdot j(\varphi^*)>f_e$. This is fulfilled whenever f_e is sufficiently small (i.e., the market entry cost are not be prohibitively high), f is sufficiently great (i.e., the average profits of active firms in the market defined by the ZCPC is not too small), σ is not too small and/or the mass of productive firms in the productivity lottery is not too small (which implicitly can be concluded from $g(\varphi)$).

<u>Comparative statics of the cutoff productivity</u>

Rewrite eq. (7) as $h(\varphi_{aut}^*) \equiv f \cdot j(\varphi_{aut}^*) - f_e / f = 0$. From the rules of implicit differentiation it follows that $\frac{d\varphi_{aut}^*}{df_e} = -\frac{\partial h(\varphi_{aut}^*)/\partial f_e}{\partial h(\varphi_{aut}^*)/\partial \varphi_{aut}^*}$ where $\frac{\partial h(\varphi_{aut}^*)}{\partial \varphi_{aut}^*} = \frac{\partial j(\varphi_{aut}^*)}{\partial \varphi_{aut}^*} < 0$. With $\frac{\partial h(\varphi_{aut}^*)}{\partial f_e} = -\frac{1}{f} < 0$ we conclude that $d\varphi_{aut}^* / df_e < 0$. By the same procedure, we find $d\varphi_{aut}^* / df > 0$, $d\varphi_{aut}^* / dw = 0$ and $d\varphi_{aut}^* / d\sigma > 0$.

To analyze the impact of a greater technological potential, rewrite $j(\varphi^*, g_a(\varphi^*))$ as follows

$$j_a(\varphi^*) \equiv j(\varphi^*, g_a(\varphi^*)) = \int_{\varphi^*}^{\infty} \left(\frac{\varphi^\sigma}{\varphi^{*\sigma-1}} - \varphi \right) g_a(\varphi) d\varphi = [1 - G_a(\varphi^*)] \cdot \int_{\varphi^*}^{\infty} \left(\frac{\varphi^\sigma}{\varphi^{*\sigma-1}} - \varphi \right) \frac{g_a(\varphi)}{[1 - G_a(\varphi^*)]} d\varphi$$

$$= [1 - G_a(\varphi^*)] \cdot E_a\left[\frac{\varphi^\sigma}{\varphi^{*\sigma-1}} - \varphi \middle| \varphi > \varphi^* \right]$$

We get $j_a(\varphi^*) - j_b(\varphi^*) = [1 - G_a(\varphi^*)] \cdot E_a\left[\frac{\varphi^\sigma}{\varphi^{*\sigma-1}} - \varphi \middle| \varphi > \varphi^* \right] - [1 - G_b(\varphi^*)] \cdot E_b\left[\frac{\varphi^\sigma}{\varphi^{*\sigma-1}} - \varphi \middle| \varphi > \varphi^* \right]$

Assume that distribution a dominates b in terms of hazard rate stochastic dominance (HRSD), so that $G_a(\bullet) \succ_{hr} G_b(\bullet)$. It then follows for any given productivity level φ^* that $[1 - G_a(\varphi^*)] > [1 - G_b(\varphi^*)]$, and with $(\varphi^\sigma / \varphi^{*\sigma-1} - \varphi)$ being an increasing function we conclude that $E_a[\bullet | \varphi > \varphi^*] > E_b[\bullet | \varphi > \varphi^*]$. Note that for $g \in (1, \infty)$, $E_a\left[\frac{\varphi^\sigma}{\varphi^{*\sigma-1}} - \varphi \middle| \varphi > \varphi^* \right] > 0$. Hence, $j_a(\varphi^*) > j_b(\varphi^*)$ so that the cutoff productivity is greater for HRSD technological potentials.

Appendix C – The link between the productivity cutoffs in the open economy

(i) From the ZCP conditions it follows that $r_i(\varphi_i^*) = (\rho \varphi_i^* P_i)^{\sigma-1} \beta L_i = \sigma w_i f_i$ and $r_{xi}(\varphi_{xi}^*) = (\tau_{ij} w_i / \rho \varphi_{xi}^*)^{1-\sigma} P_j^{\sigma-1} \beta L_j = \sigma w_i f_{xi}$. Consequently, we have

$$\frac{r_H(\varphi_H^*)}{r_F(\varphi_F^*)} = \frac{w_H f_H}{w_F f_F} \Rightarrow \frac{\varphi_H^*}{\varphi_F^*} = W^{-\sigma/(\sigma-1)} \frac{P_F}{P_H} \left(\frac{f_H L_F}{f_F L_H} \right)^{1/(\sigma-1)} \quad \text{(C1)}$$

$$\frac{r_{xH}(\varphi_{xH}^*)}{r_{xF}(\varphi_{xF}^*)} = \frac{w_H f_{xH}}{w_F f_{xF}} \Rightarrow \frac{\varphi_{xH}^*}{\varphi_{xF}^*} = W^{-\sigma/(\sigma-1)} \frac{\tau_{HF}}{\tau_{FH}} \frac{P_H}{P_F} \left(\frac{f_{xH} L_H}{f_{xF} L_F} \right)^{1/(\sigma-1)} \quad \text{(C2)}$$

$$\frac{r_{xi}(\varphi_{xi}^*)}{r_i(\varphi_i^*)} = \frac{f_{xi}}{f_i} \Rightarrow \frac{\varphi_{xi}^*}{\varphi_i^*} = \tau_{ij} \left(\frac{f_{xi}}{f_i} \right) \frac{P_i}{P_j} \left(\frac{L_i}{L_j} \right)^{1/(\sigma-1)} \quad \text{(C3)}$$

Combining (C1) and (C3) leads to $\varphi_{xH}^{*} = W^{-\sigma/(\sigma-1)} t_H \varphi_F^{*}$ and $\varphi_{xF}^{*} = W^{\sigma/(\sigma-1)} t_F \varphi_H^{*}$ where $t_i \equiv \tau_{ij}\left(f_{xi} / f_i\right)^{1/(\sigma-1)}$.

(ii) We assume that only firms that serve the domestic market can export, i.e. $\varphi_{xi}^{*} > \varphi_i^{*}$. From (C3) it follows that this holds true whenever $\tau_{ij}\left(f_{xi} / f_i\right)^{1/(\sigma-1)}\left(P_i / P_j\right)\left(L_i / L_j\right)^{1/(\sigma-1)} > 1$. Substituting $P_i = \left(\beta L_i / \sigma f_i\right)^{1/(1-\sigma)} w_i^{\sigma/(\sigma-1)}\left(\rho\varphi_i^{*}\right)^{-1}$ and rearranging yields $f_{xi} / f_j > \tau_{ij}^{1-\sigma}\left(w_j / w_i\right)^{\sigma}\left(\varphi_i^{*} / \varphi_j^{*}\right)^{\sigma-1}$.

Note that in Demidova (2008) the condition $\varphi_{xi}^{*} > \varphi_i^{*}$ implies $\varphi_{xi}^{*} > \varphi_j^{*}$ (i.e. that a domestic firm finds it easier to break even in its domestic market than a foreign exporter does) since her model assumes $W = 1$. However, in the presence of a possibly large wage differential it is quite conceivable that an exporting firm might find it easier to break even than a local firm does. Hence, the implication will not carry over to our model, in general.

Appendix D: The equilibrium condition in the open economy

The *free entry condition (FEC)* for country i is given by

$$\left(1-G(\varphi_i^{*})\right)\cdot \mathrm{E}\left[\frac{\pi_i(\varphi)}{\delta(\varphi)}\middle|\varphi > \varphi_i^{*}\right] + \left(1-G(\varphi_{xi}^{*})\right)\cdot \mathrm{E}\left[\frac{\pi_{xi}(\varphi)}{\delta(\varphi)}\middle|\varphi > \varphi_{xi}^{*}\right] = w_i \cdot f_{ei} \tag{D1}$$

As $\pi_i(\varphi) = r_i(\varphi)/\sigma - w_i f_i$, we can write the expected profits as (compare appendix A)

$$E\left[\frac{\pi_i(\varphi)}{\delta(\varphi)}\middle|\varphi > \varphi_i^{*}\right] = \frac{\pi_i(\varphi_i')}{\delta(\varphi_i')} - w_i f_i\left(E\left[\frac{1}{\delta(\varphi)}\middle|\varphi > \varphi_i^{*}\right] - \frac{1}{\delta(\varphi_i')}\right)$$

$$E\left[\frac{\pi_{xi}(\varphi)}{\delta(\varphi)}\middle|\varphi > \varphi_{xi}^{*}\right] = \frac{\pi_{xi}(\varphi_{xi}')}{\delta(\varphi_{xi}')} - w_i f_{xi}\left(E\left[\frac{1}{\delta(\varphi)}\middle|\varphi > \varphi_{xi}^{*}\right] - \frac{1}{\delta(\varphi_{xi}')}\right)$$

where $\varphi_i' \equiv \mathrm{E}\left[\varphi^{\sigma}\middle|\varphi > \varphi_i^{*}\right]^{1/\sigma}$ and $\varphi_{xi}' \equiv \mathrm{E}\left[\varphi^{\sigma}\middle|\varphi > \varphi_{xi}^{*}\right]^{1/\sigma}$. Note that both parameters are calculated using the lottery distribution.

The *zero cutoff profit conditions* (ZCPCs) are defined by $\pi_i(\varphi_i^{*}) = 0 \Leftrightarrow r_i(\varphi_i^{*}) = \sigma w_i f_i$ and $\pi_{xi}(\varphi_{xi}^{*}) = 0 \Leftrightarrow r_{xi}(\varphi_{xi}^{*}) = \sigma w_i f_{xi}$. Using the relation $r(\varphi') = \left(\varphi' / \varphi^{*}\right)^{\sigma-1} r\left(\varphi^{*}\right)$, the ZCPC can be rewritten as $\pi_i(\varphi_i') = \left[\left(\varphi_i'/\varphi_i^{*}\right)^{\sigma-1} - 1\right] w_i f_i$ (domestic ZCPC) and $\pi_{xi}(\varphi_{xi}') = \left[\left(\varphi_{xi}'/\varphi_{xi}^{*}\right)^{\sigma-1} - 1\right] w_i f_{xi}$ (export ZCPC). Plugging these expressions into (D1), substituting $\delta(\varphi') = 1/\varphi'$, $\varphi'^{\sigma} \equiv E\left[\varphi^{\sigma}\middle|\varphi > \varphi^{*}\right] = \int_{\varphi^{*}}^{\infty} \varphi^{\sigma} g(\varphi) d\varphi \Big/ \left[1-G(\varphi^{*})\right]$ and $E\left[\varphi\middle|\varphi > \varphi^{*}\right] = \int_{\varphi^{*}}^{\infty} \varphi g(\varphi) d\varphi \Big/ \left[1-G(\varphi^{*})\right]$ and finally using the link between domestic and export cutoffs, $\varphi_{xH}^* = W^{-\sigma/(\sigma-1)} t_H \varphi_F^*$ and $\varphi_{xF}^* = W^{\sigma/(\sigma-1)} t_F \varphi_H^*$, yields the equilibrium conditions as stated in eqs. (8).

Appendix E: Comparative statics under international trade

The comparative statics of the national cutoffs are determined by applying Cramer's rule to the system of equations defined in eqs. (8). This system can be rewritten as

$$\begin{pmatrix} \partial H/\partial \varphi_H^* & \partial H/\partial \varphi_F^* \\ \partial F/\partial \varphi_H^* & \partial F/\partial \varphi_F^* \end{pmatrix} \begin{pmatrix} \partial \varphi_H^*/\partial x \\ \partial \varphi_F^*/\partial x \end{pmatrix} = \begin{pmatrix} -\partial H/\partial x \\ -\partial F/\partial x \end{pmatrix} \tag{E1}$$

where x is the variable of interest. The comparative statics are derived as

$\frac{\partial \varphi_i^*}{\partial x} = \frac{|J_i|}{|J|}$ where $|J|$ is the determinant of matrix $J \equiv \begin{pmatrix} \partial H/\partial \varphi_H^* & \partial H/\partial \varphi_F^* \\ \partial F/\partial \varphi_H^* & \partial F/\partial \varphi_F^* \end{pmatrix}$ and $|J_i|$ the determinant of matrix J_i in which the column vector on the RHS of eq. (E1) is substituted for the i-th column in J. Applying Leibniz' rule, the partial derivates are given by:

$$\frac{\partial H}{\partial \varphi_H^*} = -f_H \frac{\int_{\varphi_H^*}^{\infty} \varphi^\sigma g_H(\varphi) d\varphi}{\varphi_H^{*\sigma-1}} \frac{\sigma-1}{\varphi_H^*} < 0; \qquad \frac{\partial H}{\partial \varphi_F^*} = -\frac{f_{xH}(\sigma-1)}{t_H^{\sigma-1} \varphi_F^{*\sigma}} W^\sigma \int_{\varphi_{xH}^*}^{\infty} \varphi^\sigma g_H(\varphi) d\varphi < 0$$

$$\frac{\partial F}{\partial \varphi_H^*} = -\frac{f_{xF}(\sigma-1)}{W^\sigma t_F^{\sigma-1} \varphi_H^{*\sigma}} \int_{\varphi_{xF}^*}^{\infty} \varphi^\sigma g_F(\varphi) d\varphi < 0; \qquad \frac{\partial F}{\partial \varphi_F^*} = -f_F \frac{\int_{\varphi_F^*}^{\infty} \varphi^\sigma g_F(\varphi) d\varphi}{\varphi_F^{*\sigma-1}} \frac{\sigma-1}{\varphi_F^*} < 0$$

Hence, the determinant of matrix J is given by

$$|J| = \frac{(\sigma-1)^2 f_{xH} f_{xF}}{\varphi_H^{*\sigma} \varphi_F^{*\sigma} (t_H t_F)^{\sigma-1}} \Big[(\tau_{HF} \tau_{FH})^{\sigma-1} \int_{\varphi_H^*}^{\infty} \varphi^\sigma g_H(\varphi) d\varphi \cdot \int_{\varphi_F^*}^{\infty} \varphi^\sigma g_F(\varphi) d\varphi$$
$$- \int_{\varphi_{xH}^*}^{\infty} \varphi^\sigma g_H(\varphi) d\varphi \cdot \int_{\varphi_{xF}^*}^{\infty} \varphi^\sigma g_F(\varphi) d\varphi \Big] > 0$$

As we assume throughout the paper that $\varphi_{xi}^* > \varphi_i^*$, the integrals of the subtrahend are smaller than those of the minuend. With $\tau_{ij} > 1$, it immediately follows that $|J| > 0$.

<u>Unilateral trade integration</u>

We find that $-\frac{\partial F}{\partial t_F} = \frac{(\sigma-1) f_{xF}}{W^\sigma \varphi_H^{*\sigma-1} t_F^\sigma} \int_{\varphi_{xF}^*}^{\infty} \varphi^\sigma g_F(\varphi) d\varphi > 0$, $-\frac{\partial H}{\partial t_H} = \frac{(\sigma-1) W^\sigma f_{xH}}{\varphi_F^{*\sigma-1} t_H^\sigma} \int_{\varphi_{xH}^*}^{\infty} \varphi^\sigma g_H(\varphi) d\varphi > 0$, $-\frac{\partial H}{\partial f_{xH}} = \int_{\varphi_{xH}^*}^{\infty} \varphi g_H(\varphi) d\varphi > 0$, $-\frac{\partial F}{\partial f_{xF}} = \int_{\varphi_{xF}^*}^{\infty} \varphi g_F(\varphi) d\varphi > 0$ and

$\partial H/\partial t_F = \partial H/\partial f_{xF} = \partial F/\partial t_H = \partial F/\partial f_{xH} = 0$. Hence, we get $-\frac{\partial \varphi_F^*}{\partial t_F} > 0$, $-\frac{\partial \varphi_H^*}{\partial t_H} > 0$, $-\frac{\partial \varphi_H^*}{\partial t_F} < 0$ and $-\frac{\partial \varphi_F^*}{\partial t_H} < 0$ where $t_H = \tau_{HF}\left(f_{xH}/f_H\right)^{1/(\sigma-1)}$ and $t_F = \tau_{FH}\left(f_{xF}/f_F\right)^{1/(\sigma-1)}$. Furthermore, $\frac{\partial \varphi_H^*}{\partial f_{xH}} < 0$, $\frac{\partial \varphi_F^*}{\partial f_{xH}} > 0$, $\frac{\partial \varphi_H^*}{\partial f_{xF}} > 0$ and $\frac{\partial \varphi_F^*}{\partial f_{xF}} < 0$. Hence, if a country facilitates the access to its market (i.e. $-dt_H$ or $-dt_F$ or in terms of smaller fixed export costs), its cutoff productivity decreases whereas the cutoff productivity of the other country rises.

Symmetric trade integration

By total differentiation of $\varphi_H^* = \varphi_H^*(t_H, t_F)$ and setting $dt_H = dt_F = dt$ we get $\frac{d\varphi_H^*}{dt} = \frac{\partial \varphi_H^*}{\partial t_H} + \frac{\partial \varphi_H^*}{\partial t_F}$. More specifically, we find that

$$-\frac{\partial \varphi_H^*}{\partial t_H} = \frac{(\sigma-1)^2 W^\sigma f_{xH} f_F}{\varphi_F^{*2\sigma-1} t_H^\sigma} \int_{\varphi_{xH}^*}^{\infty} \varphi^\sigma g_H(\varphi)d\varphi \cdot \int_{\varphi_F^*}^{\infty} \varphi^\sigma g_F(\varphi)d\varphi \Big/ |J| > 0$$

$$-\frac{\partial \varphi_H^*}{\partial t_F} = -\frac{(\sigma-1)^2 f_{xH} f_{xF}}{\varphi_H^{*\sigma-1} \varphi_F^{*\sigma} t_H^{\sigma-1} t_F^\sigma} \int_{\varphi_{xH}^*}^{\infty} \varphi^\sigma g_H(\varphi)d\varphi \cdot \int_{\varphi_{xF}^*}^{\infty} \varphi^\sigma g_F(\varphi)d\varphi \Big/ |J| < 0$$

The productivity in H increases by symmetric trade integration, $-\frac{d\varphi_H^*}{dt} > 0$, whenever

$$\frac{f_F W^\sigma}{f_{xF}} \frac{\varphi_H^{*\sigma-1}}{\varphi_F^{*\sigma-1}} \int_{\varphi_F^*}^{\infty} \varphi^\sigma g_F(\varphi)d\varphi - \frac{t_H}{t_F^\sigma} \int_{\varphi_{xF}^*}^{\infty} \varphi^\sigma g_F(\varphi)d\varphi > 0$$

This is the case whenever the two countries have similar business conditions, which is reflected by similar cutoff productivities (i.e. $\varphi_H^* / \varphi_F^* \approx 1$) or whenever country H has a strong comparative advantage, i.e. $\varphi_H^* / \varphi_F^* >> 1$. If country H has a strong comparative disadvantage so that $\varphi_H^* / \varphi_F^* << 1$, symmetric trade integration decreases country H 's cutoff productivity, whereas the cutoff of country F increases due to symmetry.

Changes in business conditions

Using Cramer's rule we find that $\partial \varphi_i^* / \partial f_{ei} < 0$ and $\partial \varphi_i^* / \partial f_{ej} > 0$, $\partial \varphi_H^* / \partial W > 0$ and $\partial \varphi_F^* / \partial W < 0$ where $W \equiv w_F / w_H$

Technological potential

If the technological potential of country H increases in the sense of HRSD, the value of the equilibrium condition $H\left(\varphi_H^*,\varphi_F^*\right)$ increases in the short-run (see appendix B for a proof), whereas the equilibrium condition $F\left(\varphi_H^*,\varphi_F^*\right)$ remains unchanged. Consequently, φ_H^* increases and φ_F^* decreases.

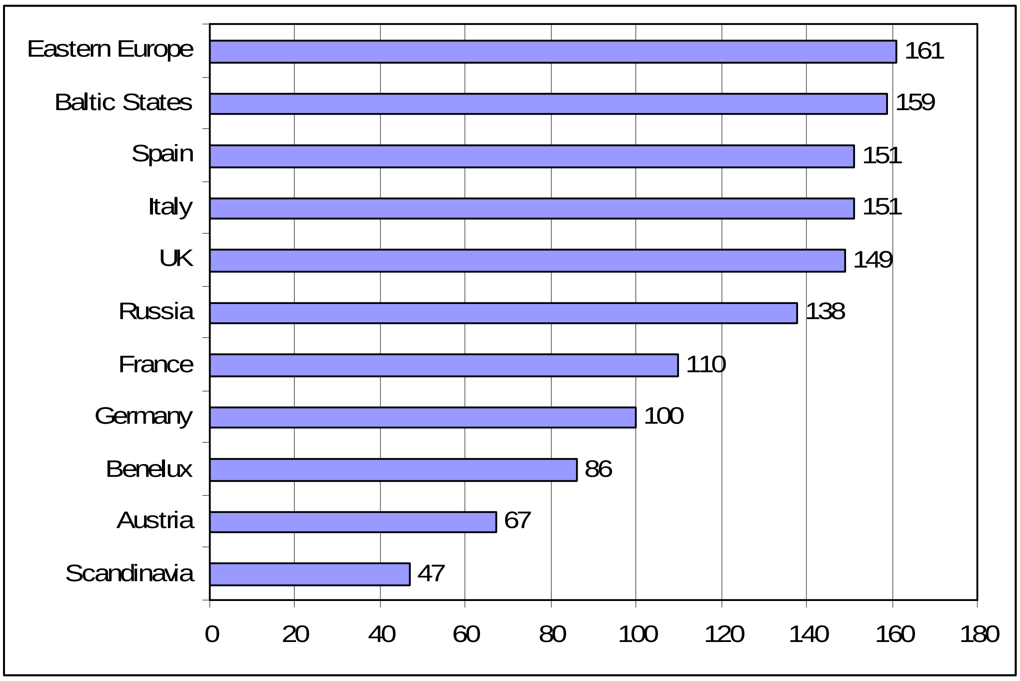
Existence and uniqueness of an international equilibrium

In equilibrium, both conditions stated in eqs. (8) have to be fulfilled. Furthermore, due to the assumptions about the lottery distribution it must hold true that $\varphi_i^* > 1$. From the comparative statics we know that the domestic cutoff decreases with domestic disadvantages and foreign advantages. Hence, we assume that the countries must not be too different *in aggregate* (as a disadvantage with respect to factor can be compensated by an advantage with respect to another) to generate positive and meaningful cutoff productivities.

Appendix F – Data Sources

Data on the perceived insolvency risks are provided by CreditReform (2009). The R&D spendings in percent of GDP in 2000 are from Bohnstedt et. al. (2010). We use the population sizes provided by the national bureaus of statistics. The Corruption Perception Index 2009 is taken from the Transparency International Website. The greater the index, the less is the perceived level of corruption. Days as well as cost and time to open up a business are provided by Djankov et. al. (2002). We take the data about labour compensation per employee calculated in 2008 USD at PPP from the OECD database provided on their website. The Ease of Doing Business rank and the Trading Across Borders rank are taken from the World Doing Business Report (World Bank 2010). A high ranking (i.e. indices closer to one) means that the business environment is more conducive to the starting and operation of a local firm. The Trading Across Borders rank captures the ease of export and import activities of local firms. It captures the number of official procedures, the time between the initiation of a shipment and its completion (including waiting time, excluding ocean transport time) and official fees. Further information is provided on www.doingbusiness.org.

Figure 1 – Perceived national risk of firm default



Source: Creditreform (2009). *Germany is indexed 100.*

Figures 2 – The correlation between specific business factors and insolvency risks

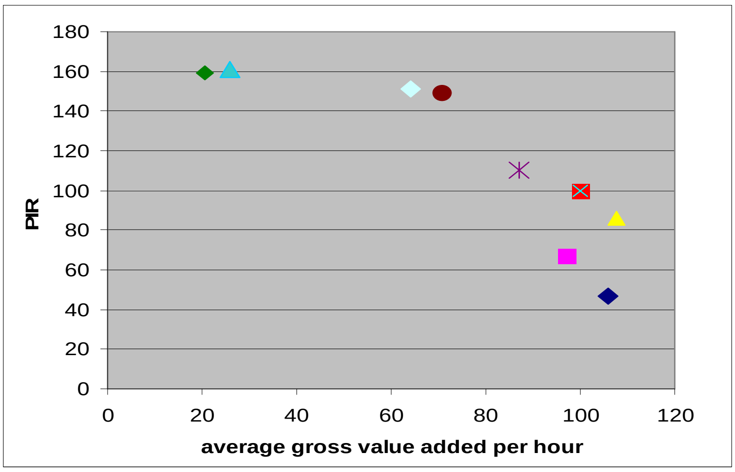


Fig. 2(i)

Legend:

Please note that due to different data availability Eastern Europe does not embrace the same set of countries in each figure. Furthermore, the values for the Baltic States, Benelux, Scandinavia and Eastern Europe are calculated as unweighted country averages.

Figures 2 (continued)

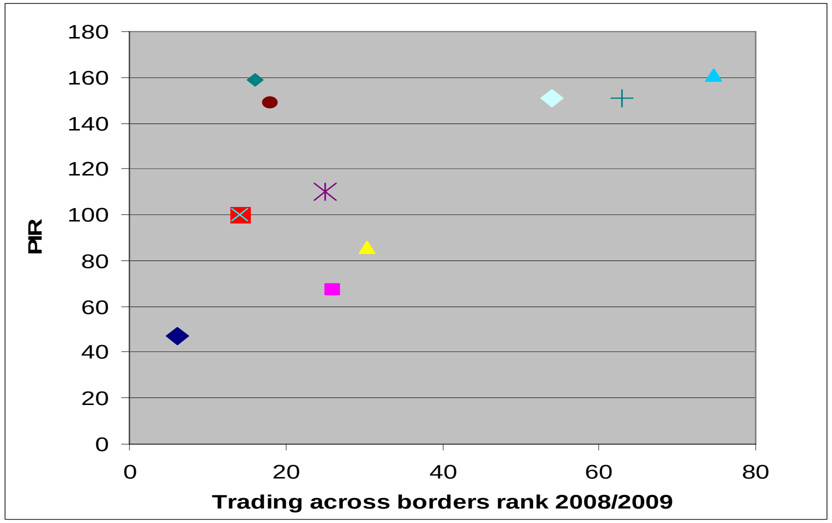


Fig. 2(ii)

Fig. 2(iii)

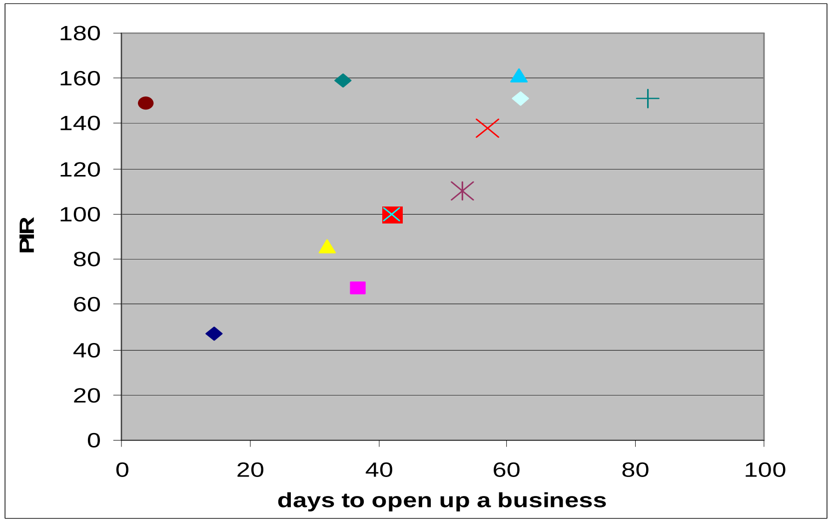


Fig. 2(iv)

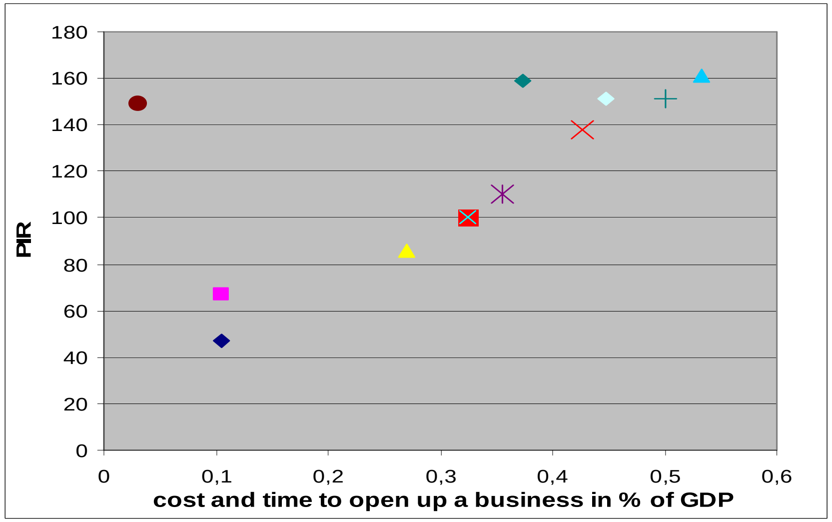


Fig. 2(v)

Figures 2 (continued)

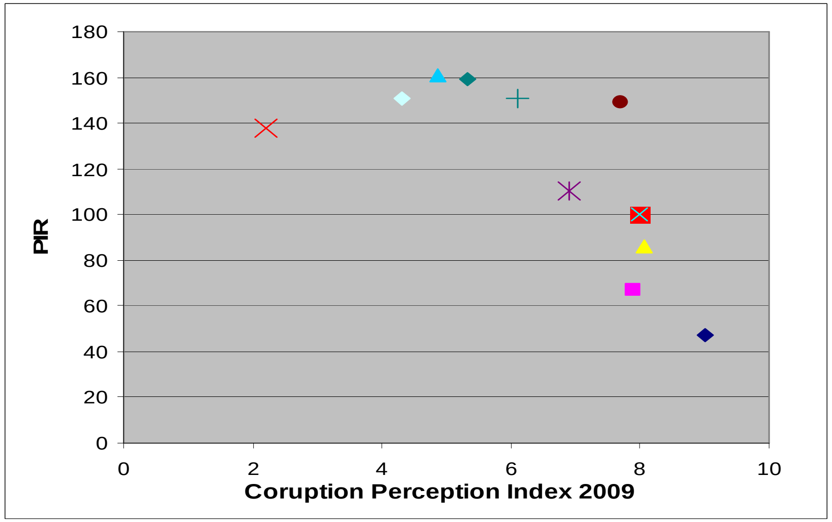


Fig. 2(vi)

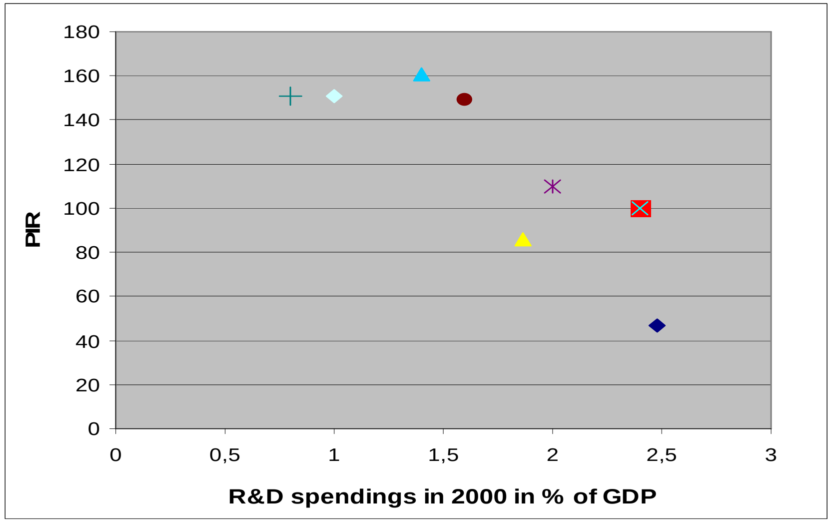


Fig. 2(vii)

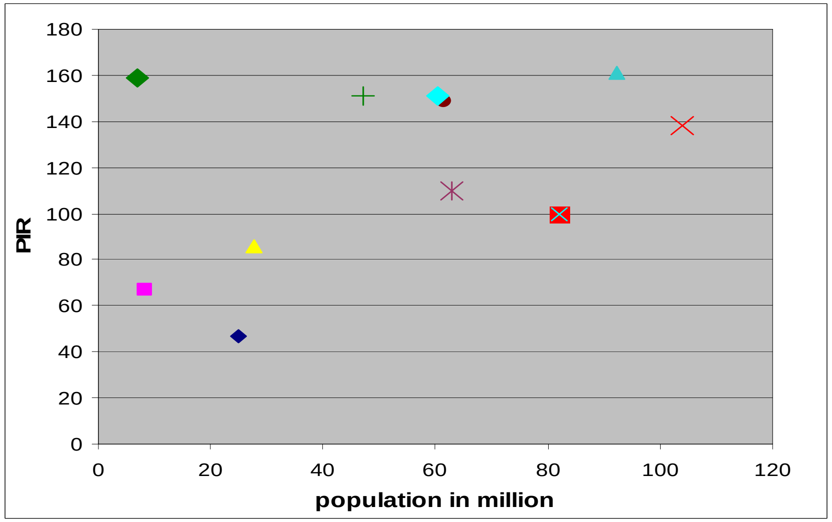


Fig. 2(viii)

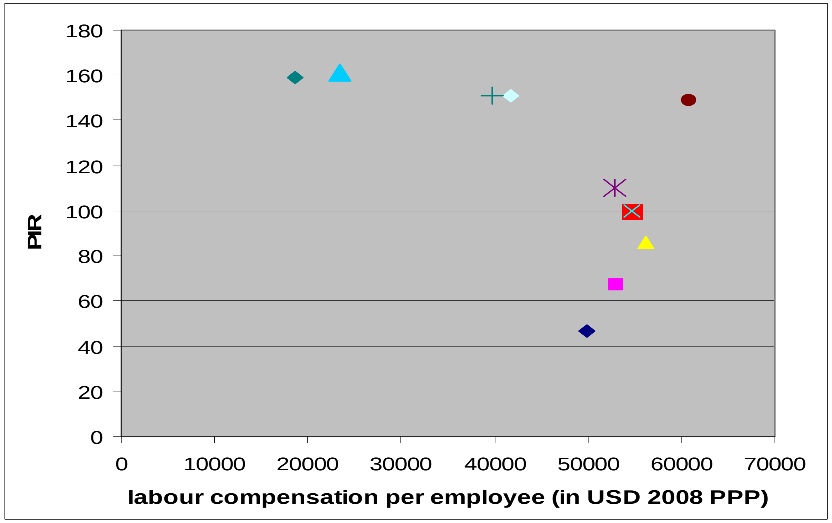


Fig. 2(ix)